YAN XIONG

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Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
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RESEARCH INTERESTS

Reinforcement learning; learning-based control; machine learning; multi-agent systems; engineering applications of artificial intelligence; robotics; aerospace; spacecraft thermal control; thermal engineering; thermal system; mechanical engineering; space telescope.

EDUCATION

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences & University of Chinese Academy of Sciences　　　　　　　　September 2018 - current
Key Laboratory of In-Orbit Manufacturing & Integrated Space Optics System, CAS
Ph.D. in Mechanical Manufacturing and Automation, advisor: Prof. Liang Guo
Dissertation: Intelligent Thermal Control Based on Deep Reinforcement Learning for Space Load

Ecole Polytechnique Fédérale de Lausanne　　　　　　　　March 2021 - April 2022
Data-driven Modelling and Control Group, Automatic Control Laboratory, School of Engineering, EPFL
Visiting PhD student, advisor: Prof. Alireza Karimi
Dissertation: Reinforcement Learning for Control of Robotic Systems

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences & University of Chinese Academy of Sciences　　　　　　　September 2016 - August 2018
Key Laboratory of In-Orbit Manufacturing & Integrated Space Optics System, CAS
Master student in Mechanical Manufacturing and Automation, advisor: Prof. Liang Guo

Shenyang Agricultural University　　　　　　　　September 2011 - June 2015
Bachelor of Mechanical Design, Manufacturing and Automation

PUBLICATIONS

Peer-reviewed Papers (First Author)

1. **Yan Xiong**, Liang Guo, Yuting Yang, Hongliang Wang. Intelligent Sensitivity Analysis Framework Based on Machine Learning for Spacecraft Thermal Design. *Aerospace Science and Technology*, 2021: 106927, DOI: 10.1016/j.ast.2021.106927.

2. **Yan Xiong**, Liang Guo, Defu Tian. Application of Deep Reinforcement Learning to Thermal Control of Space Telescope. *ASME & Journal of Thermal Science and Engineering Applications*, 2021, 14(1): 011011, DOI: 10.1115/1.4051072.

3. **Yan Xiong**, Liang Guo, Yong Huang, Liheng Chen. Intelligent Thermal Control Strategy Based on Reinforcement Learning for Space Telescope. *AIAA & Journal of Thermophysics and Heat Transfer*, 2020, 34(1): 37-44, DOI: 10.2514/1.T5774.

4. **Yan Xiong**, Liang Guo, Hongliang Wang, Yong Huang, Chunlong Liu. Intelligent Thermal Control Algorithm Based on Deep Deterministic Policy Gradient for Spacecraft. *AIAA & Journal of Thermophysics and Heat Transfer*, 2020, 34(4): 37-50, DOI: 10.2514/1.T5951.

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[0]Updated May 4, 2021. More info: **ResearchGate**; **ORCID**

5. **Yan Xiong**, Liang Guo, Defu Tian, Yang Zhang, Chunlong Liu. Intelligent Optimization Strategy Based on Statistical Machine Learning for Spacecraft Thermal Design. *IEEE Access*, vol. 8, pp. 204268-204282, 2020, DOI: 10.1109/ACCESS.2020.3036548.

6. **Yan Xiong**, Liang Guo, Defu Tian, et al. Intelligent Thermal Control Strategy Based on Machine Learning for Ultra-Large Diameter In-Orbit Assembly Infrared Telescope. *9th Applied Optics and Photonics China*, Kunming, China, November 5-7, 2020. (Accept)

7. **Yan Xiong**, Liang Guo, Defu Tian, et al. Application of Machine Learning in Thermal Control for Spacecraft. *AIAA SciTech Forum and Exposition 2021*, Nashville, US, January 11-15, 2021. (Accept)

Papers awaiting publication (First Author)

1. **Yan Xiong**, Liang Guo, Liheng Chen, Yong Huang, Hongliang Wang, Shijun Li. An Intelligent Soft Sensor Strategy for Indirect Temperature Measurement of Space Telescope. *Applied Thermal Engineering* (in revision).

2. **Yan Xiong**, Hongyi Li, Liang Guo, Rui Feng, Defu Tian. Surrogate Thermo-physical Model for Spacecraft using Deep Learning. *International Journal of Heat and Mass Transfer* (under review).

3. **Yan Xiong**, Liang Guo, Defu Tian, Liheng Chen, Yong Huang, Yang Zhang. Intelligent Thermal Design Procedure Based on Machine Learning for Lyman-alpha Solar Telescope. *IEEE Transactions on Aerospace and Electronic Systems.* (under review).

4. **Yan Xiong**, Liang Guo, Yang Zhang, Ming Li, Defu Tian. Application and Verification of Statistical Machine Learning in Spacecraft Thermal Design Optimization. *Journal of Astronomical Telescopes, Instruments, and Systems.* (under review).

Peer-reviewed Papers ((Co-author)

1. Hongliang Wang, Liang Guo, **Yan Xiong**, Boqian Xu, Funan Yu, Yan Gao, Qilong Shi. Thermal Design of Ultra-large Diameter in-orbit Assembly Infrared Telescope Sunshield. *Infrared and Laser Engineering*, Vol. 48, No. 12, 2019: 1214001-1-6, DOI: 10.3788/IRLA201948.1214001.

2. Yuting Yang, Liheng Chen, **Yan Xiong**, Shijun Li, Meng Xu. Global Sensitivity Analysis Based on BP Neural Network for Thermal Design Parameters. *Journal of Thermophysics and Heat Transfer*, 2020: 1-8, DOI: 10.2514/1.T5955.

3. Shuang Yang, Chunlong Liu, Xianwei Yang, **Yan Xiong**. Thermal Control of Space Solar Telescope. *Infrared and Laser Engineering* DOI: 10.3788/IRLA20200294.

4. Shuang Yang, Changshuai Du, Xianwei Yang, Chunlong Liu, **Yan Xiong**, Richa Hu , Xusheng Zhang , Yong Huang , Liang Guo. Thermal Control of Primary Mirror of Lyman-alpha Solar Telescope. *OPTIK*, 2021, 229: 166290, DOI: 10.1016/j.ijleo.2021.166290.

5. Yang Zhang, Hasiaoqier Han, Bang Xu, **Yan Xiong**. Kinematics of a six-dof Parallel Platform. *Mechanism and Machine Theory* (in revision).

6. Defu Tian, Liang Guo, **Yan Xiong**, Yong Huang. An Intelligent Temperature Prediction Model Based on Statistical Algorithm for Spacecraft. *Infrared and Laser Engineering* (prepare for submission).

Patents

1. Liang Guo, **Yan Xiong**, Yong Huang, Chunlong Liu, Hongliang Wang. An intelligent batch processing system for space telescope thermal analysis. Chinese invention patent(Issued No. CN201911241205.8), 2019-12-06.

2. Chunlong Liu, Shuang Yang, Xianwei Yang, **Yan Xiong**, Xusheng Zhang, Richa Hu, Yong Huang, Liang Guo. An efficient heat sink for the moving parts of space cameras. Chinese invention patent(Issued No.CN202010861130.X, 2019-08-25.

PROFESSIONAL EXPERIENCE

1. **Intelligent and Autonomous Thermal Control Systems for Space and Exploration Technologies**
   National Key R&D Program of China   Grant No. SQ2016YFHZ020827
                                                          September 2016 - current
   Research Assistant   *Professor Liang Guo*

   - Working on the research of ***multidisciplinary integrated modeling*** technology for space telescopes; Designing of the interface programs for structure, mechanics, and thermal simulation using ***MATLAB*** and ***Python***; An ***intelligent batch processing system for space telescope thermal analysis*** has been designed, and applied ***a Chinese Invention Patent***;

   - Intelligent thermal control strategy based on ***Reinforcement Learning*** for space telescope has been designed; The parameters of the active thermal control system were ***autonomous optimizated*** online without supervision, and then verified its effectiveness through ***thermal cycling experiments***, and published ***a paper published by AIAA***;

   - An efficient solution for cooling electronics on the satellites based on ***intelligent control algorithms*** and ***two-phase cooling technology***;

   - A ***transient temperature prediction model based on deep learning*** for space telescopes was designed and the performance of the prediction model was verified by simulation and ***thermal balance tests***.

2. **Intelligent Integrated System for In-orbit Simulation of Ultra-large Aperture Space Telescope Based on Deep Reinforcement Learning**
   Major Project of Scientific and Technical Supporting Programs of CIOMP   September 2017 - current
   Research Assistant   *Professor Liang Guo*

   - An ***intelligent simulation and prediction system*** for in-orbit ***transient external heat flux*** was designed, and the corresponding in-orbit transient external heat fluxes of the six surfaces of the spacecraft can be quickly obtained by inputting the attitude information such as the orbit and the beta angle;

   - An ***intelligent optimization syste***m for spacecraft thermal design parameters based on ***Reinforcement Learning*** and ***Bayesian Optimization Algorithm*** was designed, which can ***autonomously optimize*** spacecraft thermal design parameters under no supervision.;

   - The thermo-physical model of the ***ultra-large-diameter on-orbit assembly space telescope*** was established using ***UG/SST*** software, and the ***multi-layer and thin-film type sunshiel***d has been designed to meet the thermal control requirements through extensive analysis of extreme conditions.

3. **Thermal Design of Lyman-alpha Solar Telescope(ASO-LST)**
   Strategic Priority Research Program of the Chinese Academy of Sciences   Grant No. XDA15320103
                                                          July 2018 - current
   Research Assistant   *Professor Chunlong Liu*

   - The thermal physics model of LST was established based on ***I-DEAS/TMG*** and ***UG/SST*** software respectively, and the cooling solutions for CMOS and key electronics devices were analyzed and designed, followed by the ***preliminary design report***;

- Building a **surrogate model** of LST thermophysical model based on **Multi-Fidelity** and **RBF neural network**, which can greatly improve the efficiency of thermal analysis;

- **An intelligent sensitivity analysis framework** based on **Machine Learning** and intelligent batch processing system for space telescope thermal analysis was proposed, which improves the efficiency up to **10 times** compared to the traditional variance-based method;

- Intelligent thermal control strategy based on **Deep Reinforcement Learning** for space telescope was proposed; Comparing and analyzing the traditional methods, the proposed method has a **higher accuracy** of thermal control, and **small overshoot** with **stable control effect**, and published **a paper published by AIAA**.

4. **Thermal Design and Test Verification of FY3 Solar X-Ray and Extreme Ultraviolet Imager**
National Key R&D Program of China   Grant No. SQ2018YFB0504800
September 2018 - June 2019
Research Assistant   *Professor Liheng Chen*

   - The **BP neural network surrogate model** was built based on **Anaconda** software using **Python** programming, which completed the **sensitivity analysis** of the thermal design parameters of the thermal control system and guided the **optimization of the thermal design**;

   - Computing the external heat flow under **variable attitudes** in geosynchronous orbit using **MATLAB** programming, designing the basic structure of the **solar simulator** required for the component thermal balance test, and simulating the optical path of the solar simulator established using **LightTools** software;

   - To optimize distribution of the **electronic components** on the **circuit board** by programming a **genetic algorithm** in **Matlab**, and then verify the optimization strategy by **I-DEAS/TMG** software simulation.

   - The thermal design of the detector was carried out using **thermal insulation**, **thermal conductivity**, **radiation** and **heating** methods, and the thermophysical model of the imager was established by **I-DEAS/TMG** to analyze and calculate the temperature level of the imager under various **extreme conditions**, which served as a basis for further optimization of the thermal design.

5. **Other Research Experience**

   - **Tianwen-1 of CNSA**   September 2018 - December 2019

   - **XX Space Robotic Arm of CNSA**   March 2018 - March 2019

   - **XX Earth-Moon Imaging Spectrometer of CNSA**   July 2018 - June 2019

   - **Thermodynamic Optimization of Water-cooled Infrastructure for Vehicle Lithium Battery based on Exergy**   April 2019 - February 2020

INVITED TALKS AND SEMINARS

1. **2021 AIAA SciTech Forum and Exposition**, "Application of Machine Learning in Thermal Control for Lyman-alpha Solar Telescope", American Institute of Aeronautics and Astronautics (AIAA). Nashville, US   January 11-15, 2021

2. **The 9th Applied Optics and Photonics China (AOPC 2020)**, "Intelligent Thermal Control Strategy Based on Machine Learning for Ultra-Large Diameter In-Orbit Assembly Infrared Telescope", Chinese Society for Optical Engineering (CSOE), Kunming, China   November 5-7, 2020

3. **Light Conference 2019**, "Applications of Artificial Intelligence in Space Telescopes with Ultra-Large Apertures", Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences. Changchun, China   July 2019

4. **The 14th Space Thermophysics Conference**, "Thermal Design of Ultra-large Diameter in-orbit Assembly Infrared Telescope Sunshield", The Xinjiang Technical Institute of Physics &. Chemistry (XTIPC), Chinese Academy of Sciences. Urumqi, China   August 2019

5. **Light Conference 2018**, "Application of Artificial Intelligence to the Manufacture and Assembly of Space Telescopes with Ultra-Large Apertures in Orbit", Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences. Changchun, China   July 2018

6. **HXZD Intelligent Application Technology Talent Training Program**, "Deep Learning in Aerospace", Professional Qualification Certificate Training Center of China Management Science Research Institute. Beijing, China   December 2017

7. **Conference on Cognitive Robotics and Artificial Intelligence**, "Space Robotics Based on Artificial Intelligence", Shenzhen Institutes of Advanced Technology (SIAT), Chinese Academy of Sciences. Shenzhen, China   November 2017

AWARDS &. HONORS

China Scholarship Council Fellowship for Joint Ph.D. Training Program, 2020

Outstanding Students of Chinese Academy of Sciences University, 2020(10%)

Academic Scholarship of University of Chinese Academy of Sciences, 2016, 2017, 2018, 2019, & 2020(10%)

National Encouragement Scholarship, 2012, 2013, & 2014(5%)

Encouragement Scholarship for Henan Students, 2014(5%)

Second Prize of College Students' Mechanical Innovation Competition in Liaoning Province, 2014(10%)

Science and Technology Innovation Award of Shenyang Agricultural University, 2014(5%)

Second Prize of Shenyang Agricultural University Academic Award, 2012, 2014(10%)

First Prize of Shenyang Agricultural University Academic Award, 2013(5%)

SKILLS &. OTHERS

Computer: MATLAB, Python, GitHub, WordPress, Discuz, SolidWorks, NX/UG, I-DEAS/TMG, Auto-CAD, LabView, Isight, MS Office, LaTeX, EndNote, Mendeley, Adobe Illustrator, Adobe Photoshop, Origin.

Language: Chinese (native speaker), English.

Peer Review Services: *Aerospace Science and Technology; Acta Astronautica; Journal of Thermophysics and Heat Transfer; Applied Thermal Engineering; IEEE Access; Journal of Astronomical Telescopes, Instruments, and Systems; Infrared and Laser Engineering.*

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